LEGIBILITY NOTICE

A major purpose of the Technical Information Center is to provide the broadest dissemination possible of information contained in DOE's Research and Development Reports to business, industry, the academic community, and federal, state and local governments.

Although a small portion of this report is not reproducible, it is being made available to expedite the availability of information on the research discussed herein.

DOE/DP/00539--054

DE86 006957

EPA 600/4-85-030
DOE/DP/00539-054
April 1985

MASTER

CHARACTERISTICS AND MIGRATION PATTERNS OF MULE DEER ON THE NEVADA TEST SITE

by

Kenneth R. Giles
U.S. Environmental Protection Agency
Las Vegas, Nevada 89114

and

Jack Cooper
Nevada Department of Wildlife
Las Vegas, Nevada 89108

this study was conducted by the
U.S. Environmental Protection Agency
under interagency agreement
DE-4108-76DP00539
with the
U.S. Department of Energy

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
LAS VEGAS, NEVADA 89114

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

EB

MASTER

NOTICE

This report has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

CONTENTS

	Page
Figures	iii
Introduction and Acknowledgements	1
Study Area	2
Methods	4
Results and Discussion	7
Migration	8
Winter Range	10
Herd Composition and Population Estimates	11
Predation	13
Summary	16
Literature Cited	16

FIGURES

Number		Page
1	Migration pattern and hunter kill in relation to NTS and Nellis Bombing and Gunnery Range.....	3
2	Map of NTS summer and winter deer ranges.....	6
3	Ratio compositions of mule deer herd per 100 does. Echo Peak and Rainier Mesa, July through October.....	12
4	Mule deer population estimates for Echo Peak and Rainier Mesa, 1977 through 1981.....	14
5	Predator kills of mule deer during migration study.....	15

June 1984

Kenneth R. Giles
EMSL
P.O. Box 15027
Las Vegas, NV 89114

RH: MULE DEER MIGRATION. Giles and Cooper

CHARACTERISTICS AND MIGRATION PATTERNS OF MULE DEER ON THE NEVADA TEST SITE[1]

Kenneth R. Giles, EMSL, P.O. Box 15017, Las Vegas, NV 89114

Jack Cooper, Nevada Department of Wildlife, 4747 Vegas Drive, Las Vegas, NV 89108

Key words: mule deer, Nevada Test Site, migration, Clover Traps, Cap-chur gun, triangulation.

INTRODUCTION AND ACKNOWLEDGEMENTS

Two major mule deer herds (Odocoileus heminous) reside on the Nevada Test Site (NTS), apparently unaffected by nuclear testing activities. Although radionuclide analyses of animals periodically sacrificed or killed by auto traffic have shown no significant burden of radioactivity, studies of the deer's migratory patterns were prompted by their potential as carriers of radioactivity to areas accessible

---

[1]This study was conducted by the U.S. Environmental Protection Agency under interagency agreement DE-AI08-76DP00539 with the U.S. Department of Energy.

to the public (Smith, et al., 1980). The west portion of the NTS was withdrawn from public use in October 1940 for use by the U.S. Air Force (USAF) as an aerial bombing and gunnery range, and returned to Atomic Energy Commission jurisdiction in December 1961. The east portion of the site was withdrawn in April 1943 for use as a weapons testing site.

This report covers the last 6 of the 7 years (1977-1982) during which mule deer were closely observed. The study was funded by the U.S. Department of Energy and undertaken by the U.S. Environmental Protection Agency with the cooperation and support of the Nevada Department of Wildlife.

STUDY AREA

The NTS occupies 2,217 square kilometers (1,378 square miles) of Nye County, Nevada, about 104 km (65 mi.) northwest of Las Vegas. It is bordered on the east, north, and west by the USAF Nellis Bombing and Gunnery Range (Figure 1).

The topography, typically southwest desert, ranges from dry lake beds at 850 meters (2,800 feet) above sea level to the pinon-juniper forests as high as 2,200 m (7,300 ft.). Intermediate areas, deeply cut in washes and ravines, are generally alluvial fans that slope sharply from several hundred meters per kilometer to about 3 meters per kilometer in the valleys. Vegetation in the area consists mainly of desert bitterbrush (Purshia glandulosa), Gambel oak (Quercus gambeli),

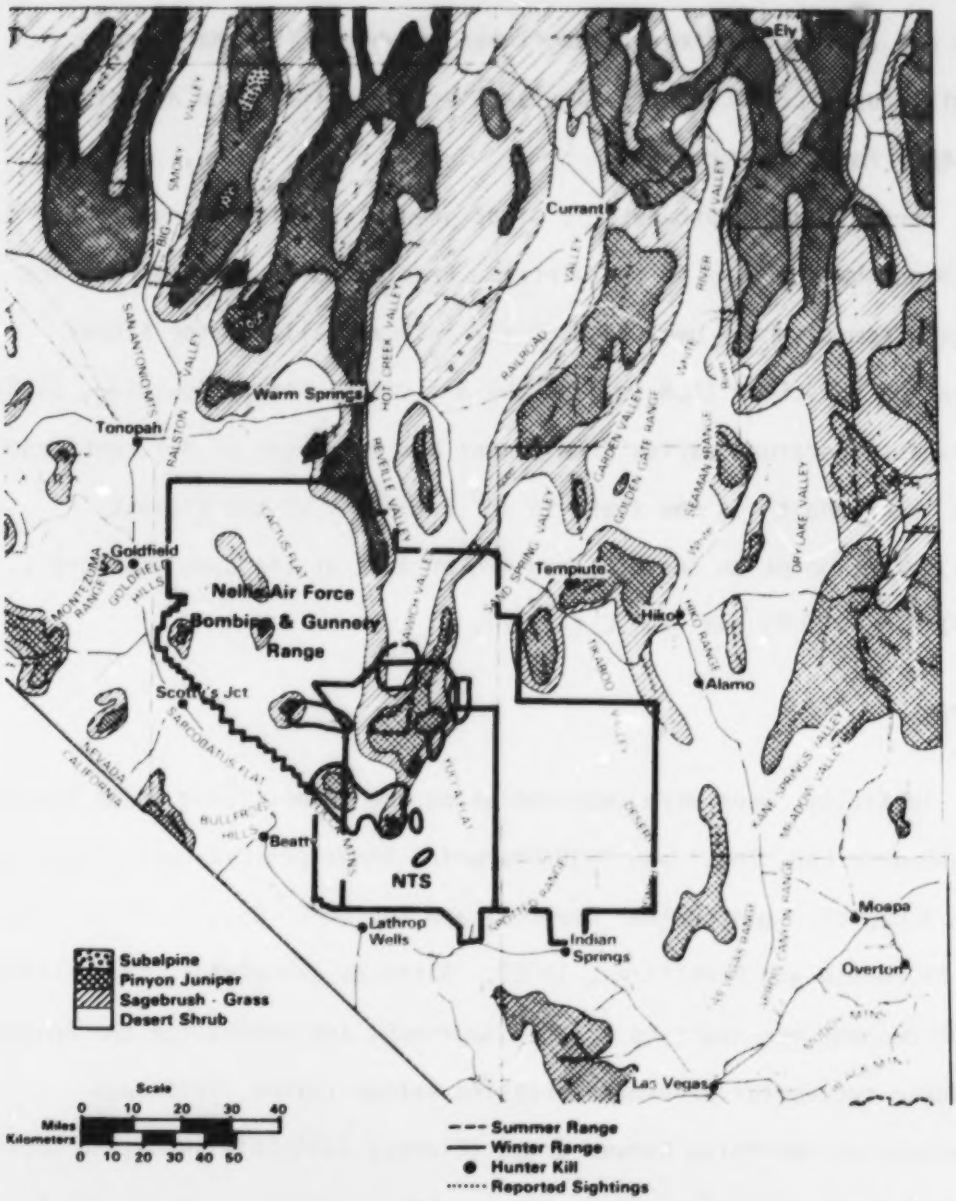

Figure 1. Migration pattern and hunter kill in relation to NTS and Nellis Bombing and Gunnery Range.

big sage (Artemisia tridentata), cliffrose (Cowania Mexicana), basin wild rye (Elymus cinereus), longflower snowberry (Symphoricarpos longiflorus), service berry (Amelanchier alnifolia), and a variety of other forbs and grasses.

Strong south-southwesterly winds predominate in the summer and north-northwesterlies in the winter. Precipitation is irregular and ranges from slightly over 28.0 cm (12 in.) annually at the higher elevation to 9.5 cm (3.8 in.) on the dry valley floors (Quiring, 1983). Average temperature varies from summer maximum highs of 46^{o} centigrade (115^{o} Fahrenheit) in the flats to 34^{o} C (94^{o} F) at the highest measurement point on the NTS, and winter lows at the same stations of -11^{o} C (13^{o} F) and -20^{o} C (-2^{o} F).

METHODS

Initially, deer were captured using the immobilizing drugs Sernylan (Bio-Ceutic Lab, Inc.) and M-99/Etorphine (American Cycnomid) injected from a Cap-chur gun (Palmer Chemical and Equipment Co., Douglasville, GA; Silberman and McWilliams, 1972). Although successful, this method required many man-hours to locate, approach, and immobilize the animals. A highly successful alternate trapping method (Giles, 1979) was developed by modifying Clover traps (Clover, 1954-56), and using water trucked in as bait since there are no other natural water sources in the area of the trap sites. Deer were also captured in other areas using a spotlight and Cap-chur gun.

All captured deer were marked with cattle ear tags (both ears). Large bucks over 90 kilograms and deer less than 2 years old were

tagged with visual markers, while all other mule deer were fitted with collars containing a miniature radio transmitter equipped with a mortality sensor (Telonics, Mesa, AZ). These transmitters operated from 1 to 3 years and could be tracked from high ground line of sight more than 40 km (25 mi.) distance. Even at such range, with two or more good radio plots, the animal could be located by triangulation with reasonable accuracy. On three occasions, animals were killed or died on the winter ranges and the radios were recovered.

Observations of deer movements were made weekly from the ground. When weather conditions limited access to the area or when deer could not be located by ground tracking, observations were made by helicopter over the area or by triangulation from fixed locations on the NTS that overlook a great portion of the winter range. The most reliable means of observation were by spotlighting at night and radio tracking during the daylight hours. Capture and tracking activity during the summer trapping period averaged 3 days and 2 nights weekly (Figure 2).

Several deer were tracked over long periods before recapture permitted replacement of inactive radios. In the Echo Peak area, 25 deer were tracked from 2 years to 4.6 years, and, on Rainier Mesa, five deer were tracked from 2 to 4.2 years.

Weekly location plots were made of each radio-tagged deer until significant movement was noticed. The most accurate radio triangulation(s) for the week was used in plotting the movement of these deer (Heezen and Tester, 1967). When significant movement of individual deer was noted, plots of the daily movement were made on a daily basis.

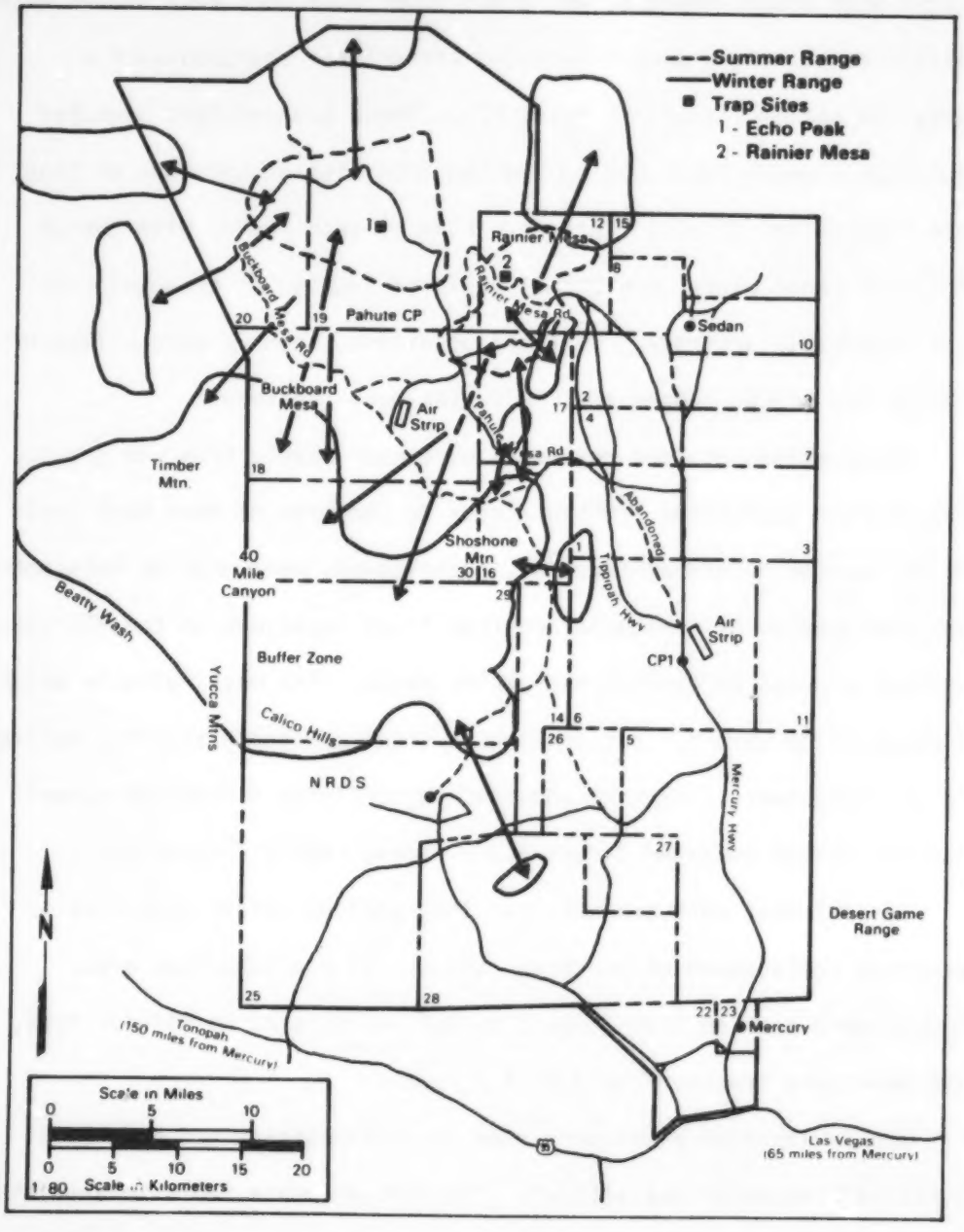

Figure 2. Map of NTS summer and winter deer ranges.

RESULTS AND DISCUSSION

The Echo Peak herd summers on Pahute Mesa in an area of about 102 km^2 (39.4 $mi.^2$) at about 2,100 m (7,000 ft.) elevation. The area is lightly forested with pinon-juniper. This is the largest concentration of deer on the NTS.

Between June 1975 and November 1982, 41 bucks and 30 does were fitted with radio telemetry devices; additionally, 21 bucks, 15 does and 10 fawns in this same herd were marked with ear and neck tags. No attempt was made to establish a daily life style for the animals since the intended purpose of the deer study was to determine their migration patterns and to locate their wintering range.

The Rainier Mesa herd summers in an approximate 150 km^2 (58 $mi.^2$) area of pinon-juniper in the north central portion of the NTS. Natural water sources include two springs and one natural reservoir that supplies water year-round on the north slope of the Mesa (Giles, 1976). There are also several construction reservoirs in the area that support tunneling operations at the base of the mesa. The Rainier study area presented other factors that had to be considered. The available water supply is located at approximately 1,760 to 1,950 m (5,800 to 6,400 ft.) elevation around the perimeter of the mesa. The study area located at the 2,160 m (7,100 ft.) elevation has natural water available only during the winter months, and, in order to hold deer in the study area during the summer trapping period, water was hauled into an established livestock tank when the deer became accustomed to using this alternate water source. The trap was constructed around the

livestock tank. A periodic trapping schedule was established so as not to disrupt deer dependency on this water source. The deer appear to have become conditioned to the vehicular traffic and equipment which are present at all hours within 1 kilometer of the trap site.

Initial capture attempts were much the same as on Echo Peak. Periodic trapping on Rainier Mesa, however, was not started until the last two years of the study when the Echo Peak trap site was closed and the equipment moved to Rainier Mesa. Trapping efforts at this location were less successful, possibly because water was more readily available around the perimeter. Also, trap time was lost due to the repeated capture of previously marked deer. As an example, a particular doe whose home range centered around the trap site was captured on numerous occasions, thus preventing other animals from entering the trap and being marked.

During the study period, 10 bucks and 11 does were fitted with radio devices by which they were tracked and their location plotted. An additional 12 bucks and two does marked with ear and neck tags were plotted through visual observations only.

MIGRATION

Maintaining contact with individual deer was not difficult during the summer and fall months because of their limited home range. The majority could be found within 2 km (1.25 mi.) of their capture area or water source and, since escape cover and feed were abundant in these areas, they seldom traveled far.

There were a few exceptions, i.e., individuals that moved about 8 km (5 mi.) for no apparent reason, sometimes staying in an area for a few days before returning. Both herds followed the same general timetable during migration: leaving their summer ranges by mid-November and nearly all vacating the summer/fall range by mid-February. A few resident deer (less than 40) remained on Echo Peak and Rainier Mesa year-round, adjusting to climatic conditions by altitudinal movement.

A portion of the Rainier Mesa herd which does not winter with the Echo Peak herd in the Timber Mountain area leaves the west side of the NTS and moves onto the Nellis Bombing and Gunnery Range around Black Mountain and in the deep canyon areas between Timber and Black Mountains. At least one radio-equipped deer was tracked off the northern edge of NTS and remained two winters in the foothills and canyons of the Belted Range area. One doe migrated as far south as Skull Mountain, 45 km (28 mi.) from her capture site (this is the southernmost movement recorded in the study).

The deer, including the majority of the Echo Peak herd and that portion of the Rainier Mesa herd that wintered in the Timber Mountain mixing area, gradually dispersed during the winter over a wide area within the western foothills of Timber Mountain and the Beatty Wash area and in the Yucca Mountain/Calico Hills area on the southern border of Forty-Mile Canyon on the western edge of the NTS (Figure 2). The most extreme movement recorded in the study involved two deer from Echo Peak (Figure 1). One 5- to 6-year-old buck spent the winter of '77-'78 on Timber Mountain and moved the following spring northwest about 120 km

(75 mi.) to Kawich Peak, where it was killed that fall by a hunter. The other deer, a 2- to 3-year-old doe trapped in mid-December at Echo Peak and tagged with ear tags and neck collar, was seen twice the following summer in the Barley Creek area of central Nevada, approximately 200 km (125 mi.) from her capture site.

It was determined from observations that the majority of deer in both herds follow the same timetable, beginning their general migration to their summer ranges in April and completing the move by mid-June. Although some individuals remained year-round within the confines of their winter range, the majority of the radio-equipped deer generally returned to the area where they were tagged. In several instances, deer were recaptured in the same clearing or within 1,500 to 2,000 m (456 to 608 ft.) of their capture site, which took place as long ago as two summers.

WINTER RANGE

About one-half of the Rainier Mesa deer herd wintered in the Shoshone Mountain area and about 40 percent of the herd wintered with the majority of the Echo Peak herd in the Timber Mountain area known as Forty-Mile Canyon, which serves as a mixing area. Approximately 10 percent of the herd remained in the study area on a year-long basis.

Of much larger dimension than the summer ranges of either herd, the Timber Mountain/Shoshone Mountain winter area ranges in vegetation from pinon and juniper at the 1,830 m (6,000 ft.) elevations to primarily dwarf sagebrush (Artemisia arbuscula) and big sagebrush (Artemisia tridentata subspecies) in the lower reaches (Beatley, 1969).

Giles

Very little water, except occasional snow, is available, with only one small spring being accessible to deer.

HERD COMPOSITION AND POPULATION ESTIMATES

The two herds studied are identified as the Rainier Mesa herd and the Echo Peak herd. All marked and unmarked deer sighted during both day and night observations were recorded. The buck:doe:fawn ratios were tabulated from data compiled from 1977 through 1981. The buck per doe ratio consistently found throughout the study on Rainier Mesa and Echo Peak was considerably higher than that reported in studies of herds off the Test Site (Figure 3). This situation is attributable to the fact that the Test Site deer are not hunted. The old aged segments of the Rainier Mesa and Echo Peak herds occupies a larger percentage of the total population than this same segment would in a herd that was subjected to hunting. This has lead to a lower fawn production and survival over a long period of time.

In contrast, the Nevada Department of Wildlife (Papez, 1976), reports a lower buck:doe ratio and a higher fawn ratio for other herds. This variance in fawn ratio is probably related to the season in which NTS observations were made (July-October), and the fact that EPA objectives were not directed toward fawn production data or fawn sex ratio data. Although at tagging time nearly all does of breeding age had fawns, or showed signs of lactation, the fawns were less easily observed in the dense vegetation and because the does tend to hide their young, especially while feeding.

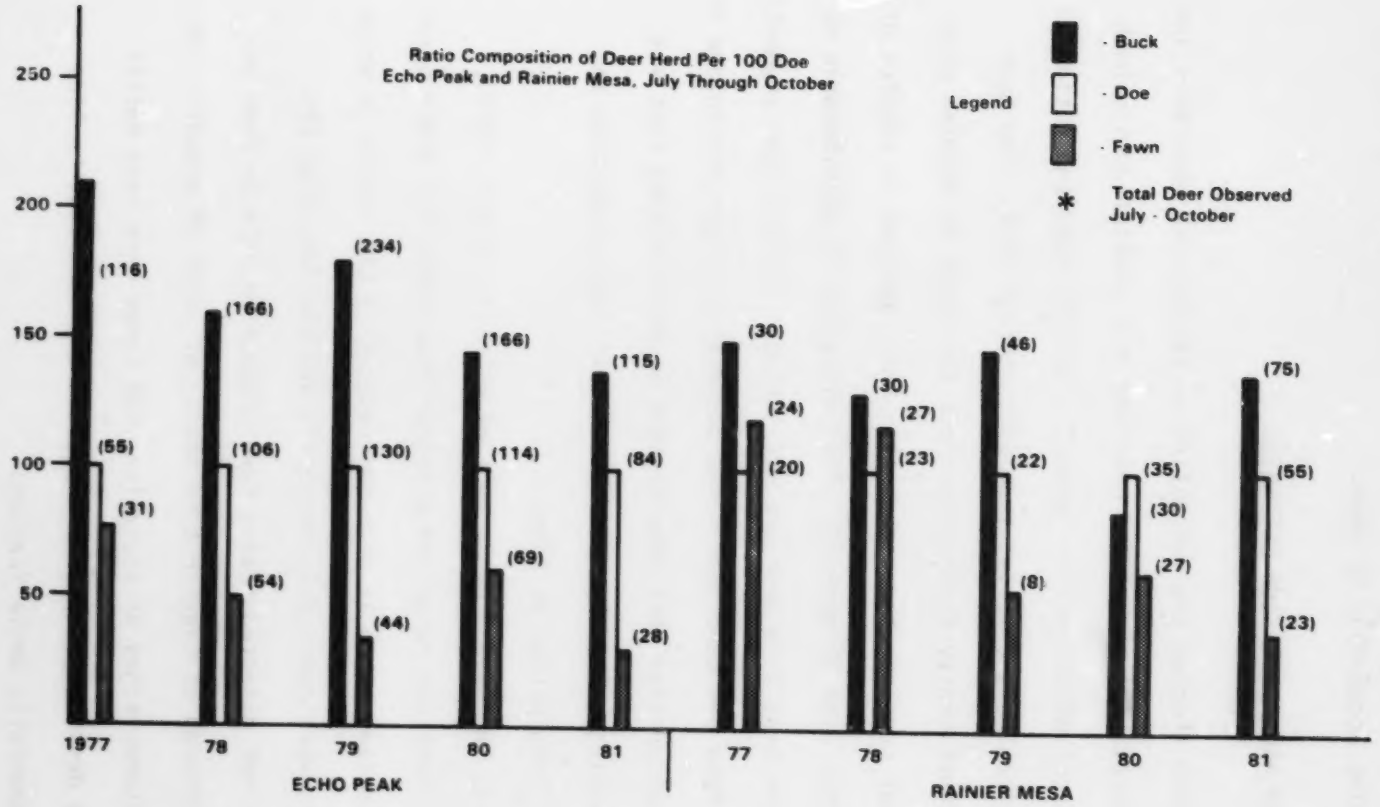

Figure 3. Ratio compositions of mule deer herd per 100 does. Echo Peak and Rainier Mesa, July through October.

Giles

It should be kept in mind that there are large areas of rugged terrain with very limited access, especially in the Echo Peak area. The observations made during the study were obtained from road surveys around the peripheral areas and at the water sources where the animals are concentrated. Figure 4 shows the total buck:doe count as well as the maximum-minimum range. These statistical values were obtained using the Lincoln-Patterson Index (Overton, et al., 1969). on Rainier Mesa in 1980, there were not sufficient observations of marked deer to establish a range. Although an attempt was made to arrive at a reasonable population figure for both deer herds on the NTS, THE EPA and other trained observers conclude that the statistically generated (estimated) figures are low. Based on the available sample data, it is estimated that there are between 1,500 and 2,000 deer total for both herds on the NTS.

PREDATION

The EPA recorded seven deer kills by large predators: six by mountain lions (Felis concolor), and one by two large coyotes (Canis latrans). In this latter incident, the deer was partially immobilized during capture attempts and was attacked by coyotes before capture could be effected. Figure 5 locates these kills; two at the Echo Peak trap site while in the capture corral. The other four kills were scattered at random throughout the summer range. On three occasions, mountain lions were trapped in the Clover trap, but escaped by chewing through the netting. No known kills can be attributed to bobcats (Lynx rufus), although they were seen on numerous occasions while spotlighting.

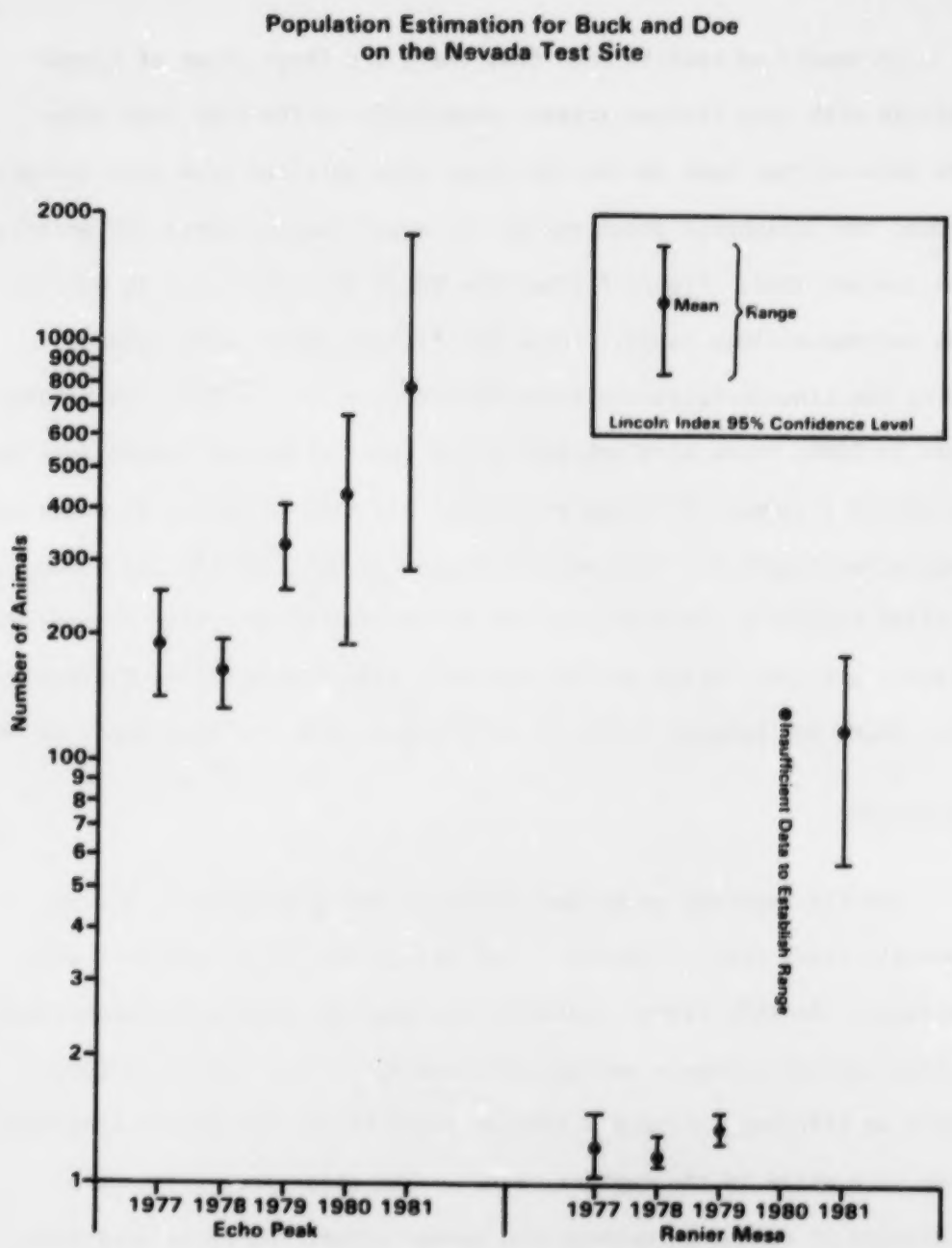

Figure 4. Mule deer population estimates for Echo Peak and Rainier Mesa, 1977 through 1981.

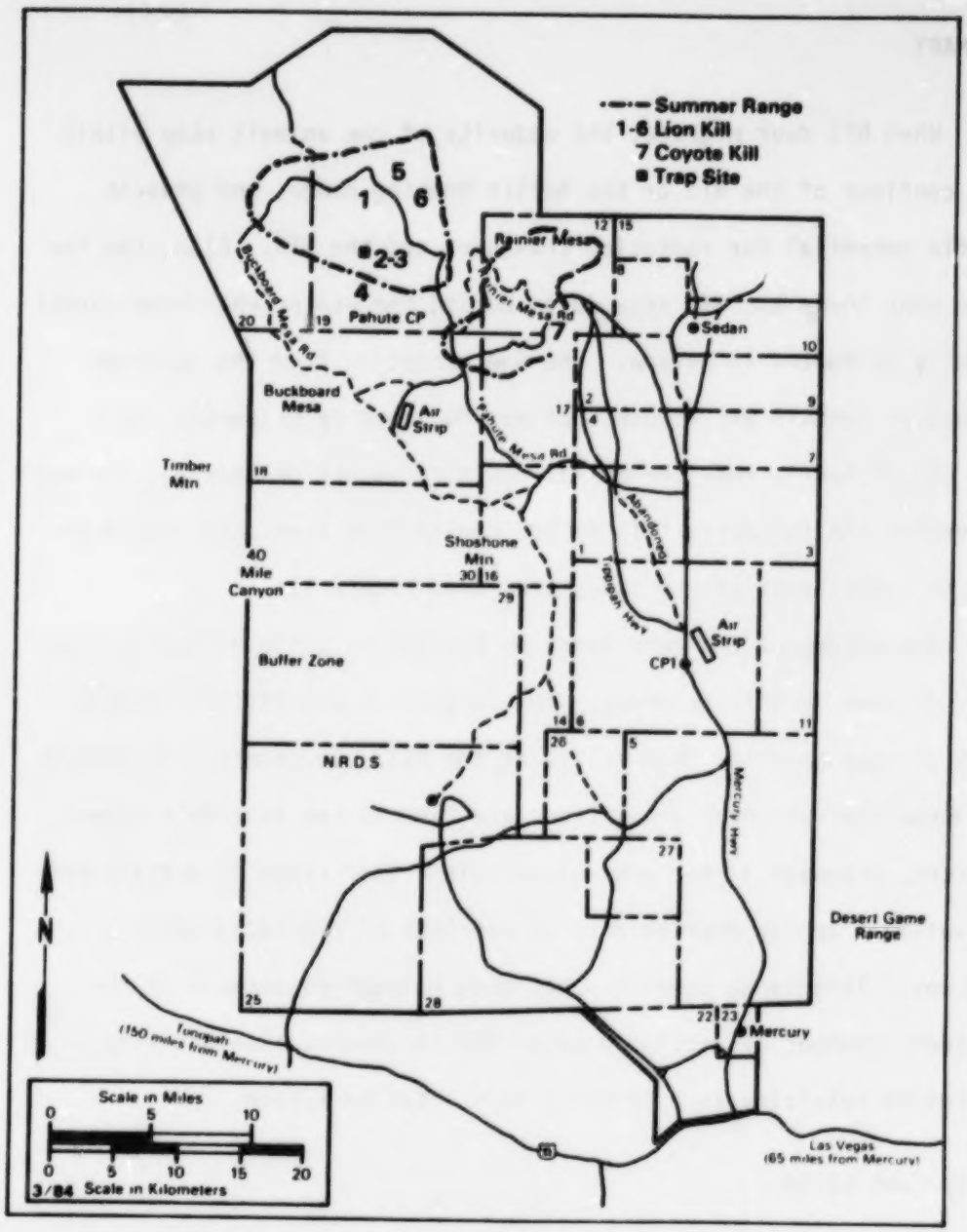

Figure 5. Predator kills of mule deer during migration study.

SUMMARY

When NTS deer migrate, the majority of the animals stay within the confines of the NTS or the Nellis Bombing Range, and present little potential for radiation transport off the NTS. Also, the few deer that leave the NTS area do so during the winter when they cannot legally be hunted in Nevada. The one exception from the apparent migration pattern was a buck that was followed by telemetry until the end of April, when the animal could no longer be located, and was harvested the following fall in the Kawich Peak area about 120.9 km (75 mi.) northwest of the study area (see Figure 1).

The makeup of the deer herds on the NTS is quite different from that of deer in offsite areas. The large buck population indicates that an aged pristine herd exists on the NTS. In general, it should be noted that the deer populations are tied to the available water sources, although a vast area of excellent deer range is present but unavailable to the deer because of the lack of available water sources. This range condition has been maintained because of the periodic changes of available water due to construction activity, therefore resulting in a browsing rest rotation system.

LITERATURE CITED

Beatley, Janice C. 1969. Vascular Plants of the Nevada Test Site, Nellis Air Force Range, and Ash Meadows. University of California, Los Angeles, 12-705.

DISTRIBUTION

Environmental Monitoring Systems Laboratory - Las Vegas, NV
T.R. Clark, Manager, DOE/NV, Las Vegas, NV
David F. Miller, DOE/NV, Las Vegas, NV
Paul J. Mudra, DOE/NV, Las Vegas, NV
Thomas M. Humphrey, Jr., DOE/NV, Las Vegas, NV
Winnie Howard, DOE/NV, Las Vegas, NV
Roger Ray, DOE/NV, Las Vegas, NV
Robert W. Taft, DOE/NV, Las Vegas, NV
Richard C. Amick, DOE/NV, Las Vegas, NV
Robert M. Nelson, DOE/NV, Las Vegas, NV
Bruce W. Church, DOE/NV, Las Vegas, NV
Technical Library, DOE/NV, Las Vegas, NV
Chief, NCB/DNA, DOE/NV, Las Vegas, NV
Hal Hollister, EP, DOE/HQ, Washington, DC
Tommy F. McCraw, EP, DOE/HQ, Washington, DC
L. Joe Deal, EP, DOE/HQ, Washington, DC
Major General William W. Hoover, Director, OMA, DOE/HQ, Washington, DC
L.A. Forsythe, OMA, DOE/HQ, Washington, DC
Jeff Swinebroad, EP, DOE/HQ, Washington, DC
Robert W. Wood, ER, DOE/HQ, Washington, DC
William S. Osburn, Jr., ER, DOE/HQ, Washington, DC
Marcy Williamson, RE SL/INEL, DOE/ID, Idaho Falls, ID
Steven V. Kaye, Oak Ridge National Lab., Oak Ridge, TN
J.T. Ensminger, ESIC, Oak Ridge National Lab., Oak Ridge, TN
C.C. Lushbaugh, Oak Ridge Associated Universities, Oak Ridge, TN
Assistant Administrator for Research and Development, EPA, Washington, DC
Director, Monitoring Systems and Quality Assurance, ORD, EPA, Washington, I
Deputy Assistant Administrator for Air and Radiation, EPA, Washington, DC
Director, Air Toxics and Radiaiton Monitoring Research Division, OMSQA, ORI
EPA, Washington, DC
Director, Office of Research Program Management, ORD, EPA, Washington, DC
Director, Air, Noise and Radiation Health Research Division, ORD, EPA,
Washington, DC
Library, EPA, Washington, DC
Regional Administrator, Region 9, EPA, San Francisco, CA
Regional Radiation Representative, Region 9, EPA, San Francisco, CA
Director, Eastern Environmental Radiation Facility, Montgomery, AL
Harold F. Mueller, NOAA/WSNSO, Las Vegas, NV
Gilbert J. Ferber, NOAA/WSNSO, Silver Spring, MD
K.M. Oswald, Manager, Health and Safety, LLNL, Mercury, NV
Richard L. Wagner, LLNL, Livermore, CA
Howard W. Tewes, LLNL, Livermore, CA

Paul L. Phelps, LLNL, Livermore, CA
Mortimer L. Mendelsohn, LLNL, Livermore, CA
J.C. Hopkins, LANL, Los Alamos, NM
Harry S. Jordan, LANL, Idaho Falls, ID
George E. Tucker, Sandia National Lab., Albequerque, NM
Carter D. Broyles, Sandia National Lab., Albuquerque, NM
Melvin L. Merritt, Sandia National Lab., Albuquerque, NM
R. Glen Fuller, Oracle, AZ
Auda F. Morrow, CETO, Mercury, NV
Arden E. Bicker, REECo, Mercury, NV
Joseph H. Dryden, NTSSO, DOE/NV, Mercury, NV
Billy Moore, DOE/NV, Las Vegas, NV
Leo Bustad, Director, Veterinary Medicine, Washington State University, Pullman, WA
Vincent Schultz, Washington State University, Pullman, WA
Arthur Wallace, University of California, Los Angeles, CA
Wesley E. Niles, University of Nevada, Las Vegas, NV
Library, University of Nevada, Las Vegas, NV
Verle R. Bohman, University of Nevada, Reno, NV
Clifton Blincoe, University of Nevada, Reno, NV
Lloyd P. Smith, President, Desert Research Institute, University of Nevada, Reno, NV
Paul R. Fenske, Desert Research Institute, University of Nevada, Reno, NV
Gary L. Dixon, U.S. Geological Survey, Denver, CO
Manager, Desert National Wildlife Range, U.S. Fish and Wildlife Service, Las Vegas, NV
Supervisor, Region III, Nevada Wildlife Department, Las Vegas, NV
Director, Nevada Wildlife Department, Reno, NV
Nevada Wildlife Research, Division of Archives, Capitol Building Annex, Carson City, NV
Ernest D. Campbell, DOE/NV, Las Vegas, NV
H.A. Pfuderer, ESIC, Oak Ridge National Lab., Oak Ridge, TN
T.P.O'Farrell, EG&G Inc., Goleta, CA - Mailing Address: 611 Avenue H, Boulder City, NV 89005
Assistant Secretary for Environmental Protection Safety, and Emergency Preparedness, DOE/HQ, Washington, DC
Dr. R.L. Davidson, Battelle Memorial Insititute, Columbus, OH
Technical Information Center, DOE, Oak Ridge, TN

Clover, M. R. 1976. Single-Gate Deer Trap and Catch Net. California Fish and Game, 40:367-373.

Giles, K. R. 1979. Springs of the Nevada Test Site and Their Use by Wildlife. U.S. Environmental Protection Agency, NERC-LV-0539-26.

Giles, K. R. 1979. A Summer Trapping Method for Mule Deer. U.S. Environmental Protection Agency, EMSL-LV-0539-27.

Heezen, Keith L. and J. R. Tester. 1967. Evaluation of Radio-Tracking by Triangulation with Special Reference to Deer Movements. J. Wildlife Management, 31:124:141.

Knox, K. L., J. G. Nagy, and R. D. Brown. 1969. Water Turnover in Mule Deer. Journal of Wildlife Management, 33:389-393.

Overton, Scott W. and David E. Davis. 1969. Estimating the Number of Animals in Wildlife Populations. Wildlife Management Techniques, 3rd Edition. pp. 433-437.

Papez, Nick J. 1976. The Ruby Butte Deer Herd. Biological Bulletin No. 5, Nevada Department of Fish and Game.

Quiring, R. F. 1983. Precipitation Climatology of the Nevada Test Site. U.S. Department of Commerce. W.S.N.S.O. 351-88, pp. 25-26.

Silberman, M. S., and L. J. McWilliams. 1972. Notes on Practical Applications of Cap-chur Equipment in Large Animal Medicine. The Georgia Veterinarian, Vol. 24, No. 3.

Smith, D. D., K. R. Giles and D. E. Bernhardt. 1980. Animal Investigation Program, 1980 Annual Report: Nevada Test Site and Vicinity. U.S. Environmental Protection Agency, EMSL-LV.